Mitigating errors of representation: a practical case study of the University Experience Survey

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The Total Survey Error (TSE) paradigm provides a framework that supports the effective planning of research, guides decision making about data collection and contextualises the interpretation and dissemination of findings. TSE also allows researchers to systematically evaluate and improve the design and execution of ongoing survey programs and future investigations.

As one of the key aims of a TSE approach is to find a balance between achieving a survey with minimal error and a survey that is affordable, it is unlikely that a considerable number of enhancements to regular programs of research can be made in a single cycle. From an operational perspective, significant alterations to data collection processes and procedures have the potential to create more problems than they solve, particularly for large-scale, longitudinal or complex projects. Similarly, substantial changes to the research approach can have an undesired effect on time series data where it can become difficult to disentangle actual change from change due to methodological refinements.

The University Experience Survey (UES) collects feedback from approximately 100,000 undergraduate students at Australian universities each year. Based on previous reviews of the UES, errors of measurement appeared to make less of a contribution to TSE than the errors of representation that were associated with the survey. As part of the 2013 and 2014 collections, the research design was modified to directly address coverage errors, sampling errors and non-response errors. The conceptual and operational approach to mitigating the errors of representation, the cost effectiveness of the modifications to the research design and the outcomes for reporting will be discussed with practical examples from the UES.

Total Survey Error

Total Survey Error (TSE) sits within a Total Survey Quality (TSQ) framework and provides an operational focus on survey design and execution. (Biemer & Lyberg, 2003). The TSE approach supports the identification and assessment of sources of error in the survey design, data collection, processing and analysis. TSE also encourages the consideration of these survey quality components within given design and budget parameters. The main criticism of TSE is that it is a theoretical, armchair exercise rather than a practical, statistical model of survey error (Groves & Lyberg, 2010). Despite this perceived shortcoming, TSE does offer a framework for a 'theory of survey design' that allows researchers to assess and prioritise key aspects of their research project (Groves, 1987).

TSE is conceptualised as being composed of sampling error and non-sampling error. Errors of representation, sampling error, occur during the sample specification and the selection of the cases from the sample frame. Errors of measurement, non-sampling error is a broader concept encompassing systematic and random errors across, for example, the survey instrument, the respondent and the mode of data collection (McNabb, 2014).

Table 1 summarises key research design components and the errors of representation that can occur in relation to each component (Biemer, 2010) (Biemer & Lyberg, 2003) (Blausis & Thiessen, 2012) (Groves, M, Crouper, Lepkowski, Singer, & Torangeau, 2009). Coverage error refers to mismatch between the population of interest and the population of the sample frame. Sampling error occurs when the incorrect people identified to participate in the survey. Non-response error is evident when sampling units do not participate in the survey or items are missing data. Adjustment error includes the use of incorrect or inappropriate weighting schema that are intended to correct for other errors of representation.

Table 1: TSE errors of representation in the context of the research design.

Research design component	Error of representation
Target population	Coverage error
Sampling frame	Sampling error
Identified sample	Non-response error
Achieved interviews	Adjustment error

Minimising or managing survey error involves mediating a balance between a survey design of the required quality standard and a design that meets the available budget. This tension between quality and budget is often most evident when the survey involves a large scale data collection program or the population of interest is challenging to access. When assessing the error profile across all components of the survey cycle, researchers also need to be aware that:

- addressing a particular component of may encroach on budget required for other mitigation activities (Blausis & Thiessen, 2012),
- 'upstream' errors such as coverage error should be fixed before implementing non-response activities (Vicente & Reis, 2012)
- minimising one source of error and increase another source of error. For example, increasing response rates could decrease representativeness (Hillygus, 2011).

As explored in subsequent sections of this paper, errors of representation presented the greatest threat to data quality in the initial stages of the implementation of the UES. A detailed examination of TSE and the UES that includes a discussion of errors of measurement can be found in Whiteley (forthcoming). While adjustment errors and the associated weighting strategies to remediation these issues result in increased variance and as such can contribute to sampling error/errors of representation they were out of scope for our input to the 2013 UES and have not been explored as part of this paper.

The University Experience Survey

With approximately 100,000 students participating each year, the UES is currently the largest national survey of higher education students. In 2013, the Social Research Centre and Graduate Careers Australia assumed responsibility for executing and improving the UES. The survey was originally developed and refined during 2011 by a consortium commissioned by the Department of Education, Employment and Workplace Relations (DEEWR).

The UES was designed to measure the engagement and satisfaction of current first and final year undergraduate students at higher education institutions. It is composed of a survey instrument, the University Experience Questionnaire (UEQ), and a survey methodology (Radloff, Coates, James, & Krause, 2011). With the initiation of the federal Quality Indicators for Learning and Teaching (QILT), the UES has become the core measure in a survey research program aimed at collecting feedback from undergraduate students, graduates and employers of graduates. As such, it is important to maximise the integrity of UES research design and execution prior to the introduction of associated quality indicators. A TSE approach was implemented to explicitly identify, explore and address the quality of the UES.

TSE and the UES

The UES can be broadly summarised as an online population survey of undergraduate university students. Representation error concerns relevant to online surveys tend to focus on coverage error and detail the shortcomings of non-probability panels that are typically used to source potential survey participants (Callegaro & Disogra, 2008), including the lack of representativeness of these panels (Blasius & Brandt, 2010) and the difficulties of generalising findings to the target population (Best, Krueger, Hubbard, & Smith, 2001) (Frippait & Marquis, 2010) particularly where potential respondents who are in-scope for the

survey are not part of the sample frame (Timmerman, 2002). Asan & Ayhan (2013) identified specific quality concerns relevant to sampling frames, or population lists, for online surveys and provided a series of weighting and adjustment procedures to correct for the resulting coverage errors.

The original conceptualisation of the UES methodology suggested that this survey was a 'special case' with the availability of a robust sampling frame and access to validated email addresses for all members of the population. Moving the UES towards this sampling frame that addressed all of the coverage error concerns associated with online surveys was a high priority for all implementations of the UES. Interestingly, as discussed in subsequent sections, the main threat to data quality was linked to over coverage rather than under coverage of the population.

Debates around non-response error associated with online surveys comment on a range of issues such as lack of access to the internet and the extent to which those invited to complete the survey do not participate (Couper, 2000). Many of these discussions are located in commentary around multi-mode surveys where online surveys are implemented because they are cost effective but low response rates require the use of supplementary data collection approaches such as CATI to undertake non-response follow-up activities (de Leeuw, 2005). There are many suggestions in the research literature regarding the nature and timing of activities to improve response rates to online surveys including offering incentives, reminder emails and the way in which the questionnaire is presented to participants (Deutskens, Ruyter, Wetzels, & Oosterveld, 2004). Recent evidence suggests that retaining a single self-administered mode of data collection may improve data quality, largely due to the absence of error introduced by interviewer effects, however it is unclear whether this observation is directly linked to the topic of the survey (Nagelhout, Willemsen, Thompson, Fong, van den Putte, & de Vries, 2010).

Many of these issues relating to non-response and response maximisation for online surveys are directly relevant to the UES and were explored as part of the survey improvement activities in 2013 and 2014. Again, the UES is somewhat of a special case as the majority of the in-scope population are young students, which is a positive sign for response rates as youth, education level and current student status are associated with frequency of internet use and an increased likelihood of participating in online surveys (Vicente & Reis, 2013). Even so, to maximise the number of reportable data cells from the UES, it was necessary to implement a broad range of non-response activities as discussed in subsequent sections.

All UES collections have been independently reviewed by Dennis Trewin, the former Australian Statistician, using a TSE approach. Summaries of the responses to the review feedback and the associated recommendations as well as the areas identified for improvement in 2013 are outlined in the following sections.

Review of the 2011 UES

As part of Trewin's 2011 review of the development of the UES (Appendix C, Radloff et al 2011:pg 59), ten likely sources of error were identified including:

- Poor questionnaire design
- Survey frame coverage
- Sample unrepresentative or inefficient (leading to inaccurate survey estimates)
- Sample selection at risk of being manipulated
- High non-response rate leading to non-response bias
- Significant item level non-response
- Coding errors and/or inconsistent coding
- Inadequate data input validation checks

- Inadequate data output validation checks, and
- Inappropriate estimation methods used.

Of these potential survey errors, the unit (student) level non-response rate was identified as the source of greatest concern. The response rate to the pilot test was only 14 per cent and while this does not necessarily lead to non-response bias, it does substantially increase the risk that this could occur.

Possible issues relating to coverage and sampling were also raised in the 2011 review of the UES. It was noted that individual universities provided a list of students that were thought to be in-scope for the UES and the sample was selected from these lists. Recommendations from the 2011 report highlighted specific concerns regarding the definition of the student population that was relevant to the UES.

An additional aspect of the survey design that could be a source of error was that some institutions were responsible for sending out invitations to participate in the UES. This led to concerns that some universities may be selective regarding which students they choose to include or exclude in the survey. The review indicated that efforts should be made to independently confirm that all selected students were approached to participate.

Overall, the 2011 review suggested that errors of representation were the primary areas for improvement in 2012. Errors of measurement, particularly those relating to the design of the questionnaire were regarded as having a negligible potential impact.

Review of the 2012 UES

The focus of Trewin's 2012 review of the UES centred on the errors of representation that had (Appendix G, Radloff et al 2012) been identified by the 2011 implementation of the UES. It was noted that errors of measurement, including questionnaire design and validity, were not a focus for methodological improvement as their precieved risk to data quality was low. The 2012 UES review found that:

- Adequate checks were undertaken to ensure that the coverage of the student population was adequate
- The survey design led to a sample that was as representative and efficient as it could be given some inherent limitations
- The student level non-response rate was high but that mitigation activities should minimise resulting bias, and
- Item level non-response was moderately high.

A key change from the 2011 to the 2012 implementation of the UES was the introduction of Computer Aided Telephone Interviewing (CATI) as a non-response mitigation strategy. It is unclear from the 2012 UES Report why the online response rate was so low but it was within two percentage points of the 2011 pilot survey. Even with the supplementary telephone interviews, the overall response rate of 24 per cent was well below the national target of 35 per cent. More importantly, there is little evidence to suggest that the telephone interviews improved representatives, particularly at an institution level as not all institutions were included in the CATI data collection program.

Another difference between the 2011 and the 2012 surveys from a TSE perspective was the marked increase in the item-level non-response. With respect to the key items of interest, the UES scales, item level non-response to the online survey ranged from 7.3 per cent to 9.5 per cent. It was suggested that this did not effect the scale estimate but remains concerning given that item level non-response was so low in 2011.

The issue of in-scope population was not resolved in 2012 and the need to provide an accurate definition of 'final year' students was again identified. Sampling was again conducted centrally from files provided by each of the 40 universities based on the assumption that the frame was reasonably sound. A firmer recommendation for centralised

administration of the survey was made however it was acknowledged that some institutions needed to resolve privacy restrictions before this could be implemented.

Mitigating errors of representation for the 2013 UES

There were two main weaknesses of the 2011 and 2012 UES survey designs that underpinned the concerns regarding errors of representation. The key concern related to the absence of a clear operational definition of the in-scope population. This resulted in the creation of a sampling frame that was inconsistent across participating institutions and almost impossible to independently verify. As such, the focus of survey error mitigation activities for 2013 was aimed at ensuring that these two issues were adequately addressed. Coverage errors were regarded as being 'upstream' of other potential risks to data quality, such as sampling, which necessitated their prioritisation.

In parallel with efforts to minimise coverage error, it was acknowledged that response rates needed to remain high and ensure as much as possible that the achieved interviews were representative of the in-scope population for the UES. As we were confident that the coverage errors would be adequately addressed before commencing fieldwork for 2013, additional strategies were put in place to mitigate survey and item-level non-response with a focus on maximising representativeness. Table 2 on the following page summarises the identified errors of representation and the range of strategies that were implemented.

Table 2. Summary of the identified errors of representation and the associated mitigation strategies implemented for the 2013 UES.

Error of representation	**Mitigation strategy**
Sample frame not representative of the student population.	Administrative data from the Higher Education Information Management System (HEIMS) data used to generate a national sample frame.
In-scope population poorly defined	Transparent definition of in-scope population created syntactically using established data elements from HEIMS.
Ineligible cases included in the sampling frame	Sample frame independently validated by institutions to ensure that ineligible cases are flagged and unavailable for selection.
Survey non-response unacceptably high	Collaborative relationships established with survey managers. Appropriate incentivisation scheme implemented. Response rates monitored and corrective action taken throughout fieldwork.
Population sub-groups underrepresented	Sample representativeness monitored and corrective action taken through targeted reminder emails and SMS' throughout the fieldwork period.
Item level non-response unacceptably high	The input controls for each item part of the questionnaire logic programmed into the survey.

Adapted from (Whiteley, forthcoming).

The following sections detail the approaches undertaken to mitigate coverage error, survey non-response, population sub-group representation and item non-response for the 2013 UES.

Coverage error

A key challenge for the 2013 collection was to operationalise a technical definition of the in-scope population that was transparent and could be applied consistently across all universities. It was also decided to used a centralised rather than a decentralised approach to building the sample to maximise uniformity and also to minimise the burden on the survey managers (so they could be freed up to focus on other mitigation issues, including response maximisation).

In both 2011 and 2012, participating institutions provided extracts from their student systems to the contractor based on a narrative definition of the in-scope population resulting in a 'bottom-up' approach to the creation of the sample frame. The UES reports indicate that the records were subsequently cleaned and coded in preparation for sample initiation.

The 2013 implementation of the UES used population data from the Higher Education Information Management System (HEIMS) to create 'top-down' sample frames for individual universities. This approach supported a consistent sampling across all institutions and minimised the chance of bias being introduced into the sample selection process.

Defining the in-scope population. HEIMS contains a data element that clearly identifies commencing students. As detailed in the following sections, the main challenge was to create a transparent operational definition of completing students.

Commencing students. Commencing students were defined as first year students who were enrolled in an undergraduate course, studying onshore, commenced study in the relevant target year; and enrolled for at least one semester. In 2012, this definition was provided to participating institutions in 2012 and it was assumed that the correct records were extracted by each institution. It is unclear whether all universities used the relevant HEIMS data element or if they cleaned this data to exclude students that were ineligible to participate (see subsequent section on Identification of Ineligible Cases).

Students conforming to the agreed definition of a commencing student were extracted from the national HEIMS Submission 1 Student File. Each university was asked to verify where possible, the active enrolment status of the students selected into the sample.

Final year students. Students in their final year of study are narratively defined as being enrolled in an undergraduate course, generally in their third year of study, and studying onshore. Each university was required to extract relevant student records from their administrative systems based on this loose definition. As noted previously, this definition

proved to be problematic for institutions resulting in confusion regarding which 'final year' students were in-scope (Radloff et al, 2012).

The lack of clarity regarding the definition of final year students seems to have resulted in the slightly unusual situation of over coverage. In 2012 445, 332 students were identified as being in-scope for the survey compared with only 341, 343 in 2013. The 2012 figure cannot be independently verified and it is likely that the definitional confusion led to the inclusion of approximately 100,000 middle years students in the sample.

Two options for operationalising the definition of final year students were investigated with a correction for course duration being the main difference. As this option adjusting for course length appeared to appropriately identify the majority of completing students for most institutions, this approach was implemented for the 2013 collection. In a small number of cases, an adjustment was made for specific institutions to take into account subject offerings outside the standard 'two semester' structure.

Identification of ineligible cases. Submission 1 HEIMS data is not formally validated and has not necessarily been subjected to the same audit and cleaning procedures as the Submission 2 file. An initial examination of the file revealed that there were marked differences between institutions in terms of their mid-year intakes, attrition rates, mid-year completions and internal course transfers. To maximise the quality of the sample data, institutions were asked to inspect the selections and update a small set of key variables.

As part of the verification process, institutions were provided with the opportunity to identify students that were out of scope for the UES. Most of the small number of exclusions related to course deferrals and enrolments in post-graduate courses. In the majority of cases, the universities chose to retain all of the students that had been selected and there was no indication at all in either 2013 or 2014 that cases were being excluded in appropriately.

Non-response error

As identified in the 2012 and 2013 reviews of the UES, unit non-response and representativeness was two areas clearly identified for future improvement. As part of the 2013 review, there appeared to be emerging concerns regarding item-level non-response. Survey and item-level non-response mitigation strategies are discussed below.

Unit level non-response. In keeping with the UES 2011 review recommendations, the main focus for fieldwork activities was on achieving the overall response rate of 35 per cent. This target was regarded as a stretch but likely to be achievable (Radloff, et al 2011). Disappointingly, the online response rate was similar to the 2011 pilot test at 20.2 per cent and select telephone interviews were required to 'top-up' underperforming institutions. While the introduction of an additional data collection mode had the potential to decrease non-response bias, there was also the possibility that it could increase measurement error through mode and interviewer effects.

A key aim of the 2013 response maximisation strategy was to ensure that the number of interviews achieved was sufficiently high to ensure that telephone non-response follow-up would not be necessary. With the support of the institutional survey managers, a 'whole-of-UES strategy was deployed that included the use of a prize draw incentive, hard-copy letters to non-responders and targeted email reminders. A prize draw was conducted for each institution, typically within two to three weeks of survey initiation to encourage students to complete the UES as soon as possible.

The non-response strategy implement for 2013 resulted in a significant increase in the overall response rate with a national increase of almost nine percentage points. All institutions, with the exception of two universities that were 'high-performers' in 2012, showed substantial response rate improvements of up to 26 percentage points. The largest reduction in response rate was 0.3 percentage points.

Table 3. Institutional, online response rates to the 2012 and 2013 UES.

	2013	2012	Change
Australian Catholic University	23.7	11.6	12.1
Bond University	32.8	6.7	26.1
Central Queensland University	36.0	25.3	10.7
Charles Darwin University	40.5	25.7	14.8
Charles Sturt University	32.3	21.7	10.6
Curtin University of Technology	26.1	23.8	2.3
Deakin University	29.2	14.7	14.5
Edith Cowan University	29.3	25.7	3.6
Flinders University	35.2	21.1	14.1
Griffith University	23.5	19.5	4.0
James Cook University	29.0	19.1	9.9
La Trobe University	33.0	20.7	12.3
Macquarie University	26.3	18.9	7.4
MCD University of Divinity	50.5	44.6	5.9
Monash University	39.7	23.3	16.4
Murdoch University	30.6	20.1	10.5
Queensland University of Technology	29.4	20.8	8.6
RMIT University	20.8	3.2	17.6
Southern Cross University	24.4	15.3	9.1
Swinburne University of Technology	25.5	13.2	12.3
The Australian National University	29.3	29.6	-0.3
The University of Adelaide	41.4	24.6	16.8
The University of Melbourne	34.5	22.0	12.5
The University of Notre Dame	26.0	17.1	8.9
The University of Queensland	32.5	24.9	7.6
The University of Sydney	30.3	23.1	7.2
The University of Western Australia	39.7	39.8	-0.1
University of Ballarat	22.1	20.4	1.7
University of Canberra	24.4	19.8	4.6
University of New England	32.9	16.3	16.6
University of New South Wales	27.0	17.5	9.5
University of Newcastle	34.0	30.9	3.1
University of South Australia	25.2	23.6	1.6
University of Southern Queensland	25.2	15.7	9.5
University of Tasmania	33.0	22.7	10.3
University of Technology Sydney	28.2	13.4	14.8
University of the Sunshine Coast	29.2	23.5	5.7
University of Western Sydney	26.6	22.2	4.4
University of Wollongong	23.5	20.1	3.4
Victoria University	17.9	10.4	7.5
Total	**29.3**	**20.2**	**9.1**

Population sub-group representation. It is apparent from Table 4 that there are number of sample parameters closely match the achieved respondent profile in 2013. Status, course of study, course of study type, ATSI status, and type of attendance are similar for both sample members and survey respondents, a finding that was consistent with the 2012 UES (Radloff, et al 2012).

Table 4. Sample and respondent characteristics for the 2013 UES.

	Sample	%	Respondents	%
Base	344,692		100,225	
Status				
Commencing	208,307	60.4	59,653	59.5
Final year	136,385	39.6	40,572	40.5
Gender				
Male	148,264	43.0	33,349	33.3
Female	196,428	57.0	66,876	66.7
Combined course of study indicator				
Combined/double degree	37,887	11.0	11,919	11.9
Single degree	306,805	89.0	88,306	88.1
Course of study type				
Bachelors Graduate Entry	4,925	1.4	1,627	1.6
Bachelors Honours	10,096	2.9	3,921	3.9
Bachelors Pass	320,155	92.9	92,808	92.6
Associate degree	4,959	1.4	908	0.9
Advanced Diploma	1,494	0.4	408	0.4
Diploma	2,811	0.8	495	0.5
Other undergraduate award	252	0.1	58	0.1
Aboriginal and Torres Strait Islander				
Indigenous	4,126	1.2	1,067	1.1
Non-Indigenous	334,617	97.1	97,535	97.3
Not stated	5,949	1.7	1,623	1.6
Type of attendance code				
Full-time	307,739	89.3	90,137	89.9
Part-time	36,953	10.7	10,088	10.1
Language spoken at home code				
English	258,416	75.0	77,208	77.0
Language other than English	81,537	23.7	21,931	21.9
Not stated	4,739	1.4	1,086	1.1
Citizen/resident indicator				
Domestic	294,662	85.5	88,067	87.9
International	50,030	14.5	12,158	12.1

Gender bias is still clearly apparent in the 2013 UES with a substantially lower response rate for males, a finding that was also observed in relation to the 2012 collection. For the 2012 survey, the proportion of male online respondents was 35.1%, similar to the 33.3% achieved in 2013. It should be noted that the significant increase in response rate from between 2012 and 2013 did not proportionally increase the level of gender bias which was a positive outcome.

Item level non-response. As the 2012 UEQ was administered in two modes, CATI and online, only the online component of the 2012 collection was compared to the 2013 data. In 2012, the average item-level non-response increased substantially from the pilot test of the UES to 7.7 per cent. For the 2013 survey, average item non-response was reduced significantly to 1.0 per cent.

An inspection of some of the items with higher levels of non-response suggests that the question wording may be contributing to students refusing or being unable to answer. Using the acdavail (1.4 per cent non-response) and acdhelp (1.5 per cent non-response) items as examples it is evident that the question stems and response frames are not as harmonious as they could be.

acdintro During 2013, to what extent have you found <u>academic or learning advisors</u> to be…

STATEMENTS

acdavail	Available?
acdhelp	Helpful?

RESPONSE FRAME

1. Had no contact
2. Not at all
3. Very little
4. Some
5. Quite a bit
6. Very much

Looking at these question stems and the response frame, it is unclear what 'quite a bit available' or 'some helpful' actually means. It would be useful to cognitively test these items or a refreshed response frame prior to the next implementation of the UES. Revising the UES in 2013 or 2014 was not possible due to timeframe constraints.

Mitigating errors of representation for the 2014 UES

Sampling error

As there were so many concerns about the quality of the sample frame and the accuracy of the sample selection from the 2012 collection, it was decided to address coverage issues before remediating the sampling errors. Table 5 summaries the sampling errors and the mitigation activities that were undertaken in 2014. These sampling errors and the relevant strategies are interdependent and, as such, a combined discussion of sample size, margin of error and anticipated response rate is provided in the following section.

Table 5. Summary of the identified sampling errors and mitigation strategies implemented for the 2014 UES.

Sampling errors	**Mitigation strategy**
Sample size inappropriate	Implement an approach that supports accurate sampling at a strata level (rather than nationally)
Margin of error higher than expected	Moderate expectations regarding precision of estimates

(Whiteley, forthcoming).

In 2012 and 2013, a similar approach was used to identify the appropriate sample size for the UES collections. Strata were created based on 45 Study Areas and current status (commencing or completing). Based on the sampling rules in the 2012 UES National Report, strata with up to 1,333 in-scope students were a census and a random selection of 1,333 students was taken from lager strata. The logic behind the selection approach was that a

sample of 1,333 would yield at least 200 completed interviews and these 200 interviews would ensure that a confidence interval of ±5 per cent at a 95 per cent level of confidence.

It was apparent during the set up and fieldwork phases of the 2013 UES that the method used to determine sample size was less than optimal. Specifically, this approach did not take into account the wildly differing response rates across strata which led to the substantial oversampling of large strata resulting in:

- achievement rates of more than 200 completed interviews
- over representation of these groups, and
- an increased gender imbalance.

Based on observations during the 2013 fieldwork, it was evident that the large strata tended to be in Study Areas that included female dominated courses such as nursing and teaching. As females are generally more likely participate in surveys the naturally higher response rate and absence of quotas for strata resulted in an excess of female participants.

For the 2014 UES collection, a two stage approach was undertaken to determining sample size and the number of student records that would need to be selected to achieve these targets. Sample sizes were calculated at the strata level taking into account the number of records available for sampling and the requirement to report data at a 90% confidence level, +/- 5%. A finite population correction was also applied to each stratum.

When the response rates required to achieve the number of completed surveys for each stratum were analysed, it was apparent for a large proportion of strata that the necessary targets were unachievable based on the known response rates to the 2012 survey. The key driver of the need for extremely high response rates resulted from the fact that a student numbers were comparatively small in most subject areas for many institutions. Using the revised 2014 approach to sampling, almost all strata required a census and in many cases a response rate of between 70 and 100 per cent was required.

In consultation with the department, the level of reporting precision was modified to a 90% confidence level +/- 7.5%. In almost all instances, the number of records that needed to be sampled was retained but the required response rate was lowered to a level that was more achievable. It was still the intention of the operational team to aim for a 5% confidence interval and this was used as a 'background target' with a view to making this the actual target in future implementations of the UES.

As was the case in 2013, selected sampled was checked against the population to confirm that gender, qualification, mode of attendance, broad field of education and citizenship characteristics were appropriately represented in the sample.

Overall quality improvement & cost effectiveness

The approach to conducting the UES for the 2013 and 2014 cycles was based on a careful consideration of potential sources of survey error tempered by an appreciation of the compressed timeline for both cycles of data collection. The TSE framework provided a:

- conceptual framework for evaluating the design of the UES,
- structured approach to making decisions about modifying the UES to support continuous improvement,
- method for determining an optimal research design that offered good value for money,
- way to prioritise survey errors for mitigation, and a
- means to challenge accepted paradigms regarding response rate as the primary indicator of a 'good' survey.

The survey framework implemented for the 2013 and 2014 UES was designed to address errors of representation that had been identified as part of the previous methodological reviews. More specifically:

- Using HEIMS, creating an effective operational definition of ‘completing’ students and a transparent sample selection validation process reduced coverage errors.
- A more detailed sampling strategy and close monitoring of study area targets within institutions decreased sampling errors.
- Increased unit level response rates and a reduction in item-level non-response contributed to a lessening of non-response errors.

Overall the greatest reduction in error was realised by addressing the population over coverage and it appears to be the case that while there are some small improvements that can be made in relation to the definition of students in their final year, there is little to be gained from an ongoing focus on coverage error. There is still evidence of sampling and non-response issues that need to be resolved and these areas have been targeted for ongoing attention prior to the 2015 UES. It is unlikely that the sampling issues will be fully resolved in the short term due to the requirement for very high response rates from students enrolled at smaller institutions however continuing to use a TSE framework will ensure that all relevant avenues are explored within budget.

As suggested previously, a TSE approach usefully incorporates an appreciation of cost constraints in relation to achieving quality survey outputs. Based on our analysis of the 2013 and 2014 UES collections, the cost of implementing the improvements was budget neutral. Mitigating non-response error, and mode effects, by improving online response rates through the use of hard-copy letters to individual students was similar to the cost incurred for the telephone non-response follow up phase of the 2012 UES. Coverage error and sampling error were minimised through the effective implementation of strategies to use existing administrative data, such as HEIMS, and resources to ensure a positive outcome.

The observation that the theoretical TSE framework doesn’t provide unambiguous answers to questions about an optimal research design is correct but TSE does support a logical approach

to making evidence-based decisions about trade offs between survey quality and cost. Thinking about research execution from the perspective of TSE also provides researchers with an opportunity to reflect on their research practice and identify areas for improvement.

Bibliography

Asan, Z., & Ayhan, H. O. (2013). Sampling frame coverage and domain adjustment procedures for internet surveys. *Quality & Quantity, 47*, 3031-3042.

Best, S., Krueger, B., Hubbard, C., & Smith, A. (2001). An Assessment of the Generalisabiity of Internet Surveys. *Social Science Computer Review, 19*(2), 131-145.

Biemer, P. (2010). Total Survey Error: Design, Implementation and Evaluation. *Public Opinion Quarterly, 74*(5), 817-848.

Biemer, P., & Lyberg, L. (2003). *Introduction to Survey Quality.* USA: John Wiley & Sons.

Blasius, J., & Brandt, M. (2010). Representativeness in Online Suveys through Stratified Samples. *Bulletin de Methodologie Sociologique, 107*(5), 5-21.

Blausis, J., & Thiessen, V. (2012). *Assessing the Quality of Survey Data.* USA: Sage Publications.

Borden, V., Massa, T., & Milam, J. (2001). Technology and tools for institutional research. In R. (. Howard, *Institutional Research: Decision Support in Higher Education* (pp. 201-209). Tallahassee, Florida.

Borken, B. (2010). The Mode Effect in Mixed Mode Surveys: Mail and Web Surveys. *Social Science Computer Review, 28*(3), 371-380.

Callegaro, M., & Disogra, C. (2008). Computing response metrics for online panels. *Public Opinion Quarterly, 72*(5), 1008-1032.

Couper, M. (2000). Web Surveys: A review of issues and approaches. *The Public Opinion Quarterly, 64*(4), 464-494.

Crow, D., Johnson, M., & Hanneman, R. (2011). Benefits and Costs of Multi-Mode Survey of Recent College Graduates. *Survey Practice, 4*(5), 1-6.

de Leeuw, E. (2005). To Mix or not to Mix Data Collection Modes in Surveys. *Journal of Offical Statistics, 26*(2), 233-255.

Deutskens, E., Ruyter, K., Wetzels, M., & Oosterveld, P. (2004). Resposne Rate and Response Quality of Internet-Based Surveys: An Experimental Study. *Marketing Letters, 15*(1), 21-36.

Frippait, D., & Marquis, N. (2010). Web Surveys in the Social Sciences: An Overview. *Population, 65*(2), 285-312.

Groves. (1987). Research on Survey Data Quality. *Public Opinion Quarterly, 51*(2), 156-172.

Groves, R., & Lyberg, L. (2010). Total Survey Error: Past, present and future. *Public Opinion Quarterly, 74*(5), 849-879.

Groves, R., M, F. F., Crouper, M., Lepkowski, J., Singer, E., & Torangeau, R. (2009). *Survey Methodology.* New Jersey: Wiley.

Hillygus, S. (2011). The Practice of Survey Research: Changes and Challenges. In A. Berinsky, *New Directions in Public Opinion* (pp. 32-51). Routledge.

McNabb, D. (2014). *Nonsampling error in social surveys.* USA: Sage.

Nagelhout, G., Willemsen, M., Thompson, M., Fong, G., van den Putte, B., & de Vries, H. (2010). Is web interviewing a good alternative to telephone interviewing? Findings from the International Tobacco Control (ITC) Netherlands Survey. *Public Health, 10*, 351-361.

Radloff, A., Coates, H., James, R., & Krause, K. (2011). *Report on the Development of the University Experience Survey.* Canberra: Australian Government.

Radloff, A., Coates, H., Taylor, R., James, R., & Krause, K. (2012). *2012 University Experiene Survey National Report.* Canberra: Australian Government.

Timmerman, A. (2002). *Introduction to the Application of Web-Based Surveys.* North Carolina: Department of Public Instruction.

Vicente, P., & Reis, E. (2012). Coverage error in internet surveys: Can fixed phones fix it? *International Journal of Market Research, 54*(2), 323-345.

Vicente, P., & Reis, E. (2013). The "frequency divide": implictions for internet-based surveys. *Quality & Quantity, 47*, 3051-3064.

Whiteley, S. (forthcoming). Total Survey Error & Institutional Research: A case study of the University Experience Survey. *Australasian Association for Institutional Research.*